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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/010,162	11/20/2001	Fwu-Iuan Hshieh	GS 149	7266

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EXAMINER

ROMAN, ANGEL

ART UNIT PAPER NUMBER

2812

DATE MAILED: 12/31/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/010,162

Applicant(s)

HSIEH ET AL.

Examiner

Angel Roman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 October 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 12-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 12-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 13 October 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Drawings

1. The drawings were received on 10/13/03. These drawings are not acceptable. The drawings are objected to because the lines and numbers defining the drawings are blurred and not clearly legible. A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

INFORMATION ON HOW TO EFFECT DRAWING CHANGES

Replacement Drawing Sheets

Drawing changes must be made by presenting replacement figures which incorporate the desired changes and which comply with 37 CFR 1.84. An explanation of the changes made must be presented either in the drawing amendments, or remarks, section of the amendment. Any replacement drawing sheet must be identified in the top margin as "Replacement Sheet" and include all of the figures appearing on the immediate prior version of the sheet, even though only one figure may be amended. The figure or figure number of the amended drawing(s) must not be labeled as "amended." If the changes to the drawing figure(s) are not accepted by the examiner, applicant will be notified of any required corrective action in the next Office action. No further drawing submission will be required, unless applicant is notified.

Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin.

Annotated Drawing Sheets

A marked-up copy of any amended drawing figure, including annotations indicating the changes made, may be submitted or required by the examiner. The annotated drawing sheets must be clearly labeled as "Annotated Marked-up Drawings" and accompany the replacement sheets.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.85(a). Failure to take corrective action within the set period will result in ABANDONMENT of the application.

If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings **MUST** be filed within the **THREE MONTH** shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may **NOT** be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 12-14, 17-20 and 22 are rejected under 35 U.S.C. 102(b) as being anticipated by Zeng et al. U.S. Patent 6,121,089 A.

Zeng et al. discloses a method of forming a trench MOSFET comprising; providing a semiconductor wafer 112 of a first conductivity type; depositing an epitaxial layer 114 of said first conductivity type over said wafer, said epitaxial layer 114 having a lower majority carrier concentration than said wafer 112 forming a body region 122 of a second conductivity type within an upper portion of said epitaxial layer 114; providing a patterned first masking material layer 116 over said epitaxial layer 114, said patterned first masking material layer 114 comprising a first aperture; depositing a second masking material layer 128 over said first masking material layer 114; etching said second masking material layer 128 using an anisotropic dry oxide etching process (see column 11, lines 50-53) until a second aperture is created in said second masking

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material layer 128 within said first aperture, said second aperture being narrower than said first aperture (see figure 4D); forming a trench 130 in said epitaxial layer 114 by etching said semiconductor wafer 112 through said second aperture(see figure 4E) using a reactive ion etching process (see column 11, lines 54-56); forming an insulating layer 132 lining at least a portion of said trench 130; forming a conductive region 134 within said trench 130 adjacent said insulating layer 132; and forming a source region 126 of said first conductivity type within an upper portion of said body region 122 and adjacent said trench 130; wherein a lateral thickness of said source region is independent of the measurement of the distance between the first and second apertures (see figure 4J).

Said patterned first masking material layer 116 is provided over said semiconductor wafer 112 by a method comprising; providing a first masking material layer 116 over said epitaxial layer 114; applying a patterned positive photoresist layer 118 over said first masking material layer 116; and etching said first masking material layer 116 through an aperture in said patterned photoresist layer 118 such that said first aperture is formed in said first masking material layer 116 (see figure 4A).

Said semiconductor wafer 112 is a silicon wafer (see column 8, line 51-53) and said epitaxial layer 114 is a silicon epitaxial layer (see column 11, lines 14-25).

4. Claims 12-20 and 22 are rejected under 35 U.S.C. 102(e) as being anticipated by Kubo U.S. Patent 6,429,078 B2.

Kubo discloses a method of forming a trench MOSFET comprising; providing a silicon semiconductor wafer 1 of a first conductivity type; depositing a silicon epitaxial layer 2 of said first conductivity type over said wafer 1, said epitaxial layer 2 having a lower majority carrier concentration than said wafer 1; forming a body region 4 of a second conductivity type within an upper portion of said epitaxial layer 2; providing a patterned first masking material layer 5 over said epitaxial layer 2, said patterned first masking material layer 5 comprising a first aperture (see figure 2); depositing a second masking material layer 7 over said first masking material layer 5; etching said second masking material layer 7 until a second aperture is created in said second masking material layer 7 within said first aperture, said second aperture being narrower than said first aperture (see figure 4); forming a trench 9 in said epitaxial layer 2 by etching said semiconductor wafer 1 through said second aperture using a reactive ion etching process (see column 4, lines 59-67), and removing the first masking material layer 5 and the second masking material layer 7 prior to forming an insulating layer 11 lining at least a portion of said trench, forming a conductive region 13 within said trench 9 adjacent said insulating layer 11, and forming a source region 15 of said first conductivity type within an upper portion of said body region 4 and adjacent said trench 9; wherein a lateral thickness of said source region 15 is independent of the measurement of the distance between the first and second apertures. 13. Kubo also discloses patterning the first masking material layer 5 by depositing a first masking material layer 5 using chemical vapor deposition over said epitaxial layer 2, applying a patterned photoresist layer (positive resist layer) over said first masking material layer 5,

and dry etching said first masking material layer 5 through an aperture in said patterned photoresist layer such that said first aperture is formed in said first masking material layer (see column 4, lines 10-29). The first and second masking layers are silicon dioxide layers of the same composition (see column 4, lines 14-44). The first trench mask aperture is about one micrometer in smallest dimension and said second trench mask aperture ranges from 0.2 to 0.6 micrometers in smallest dimension (see column 4, lines 21-22 and 53-58).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein

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were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kubo U.S. Patent 6,429,078 B2.

Kubo is applied as above but lacks anticipation on disclosing a first trench mask aperture range of 0.4-0.8 micrometers, however it would have been obvious to a person having ordinary skills in the art at the time the invention was made to disclosed a first trench mask aperture of 0.8 micrometer in the primary reference of Kubo since Kubo teaches forming a first mask aperture of about 1 micrometer, e.g. 0.8 micrometer. Furthermore selecting a value of 0.8 micrometer for the first mask aperture in the primary reference of Kubo is only considered to be routine optimization of the process disclosed by Kubo and a person having ordinary skills in the art at the time the invention was made would have found obvious to provide by performing routine experimentation based on a desire accuracy of the suggested first mask aperture width value.

Response to Arguments

9. Applicant's arguments with respect to claims 12-22 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

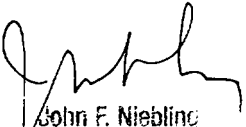
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Angel Roman whose telephone number is (703) 306-0207. The examiner can normally be reached on Monday-Friday 8:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John Niebling can be reached on (703) 308-3325. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

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For inquiries directed to the examiner or examiner's supervisor after 2 February 2004 call Angel Roman at (571) 272-1681 or John Niebling at (571) 272-1679.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.


John F. Niebling
Supervisory Patent Examiner
Technology Center 2800

AR
22 December 2003